

The wasp and bee fauna of the Ridö archipelago in Lake Mälaren, Sweden (Hymenoptera, Aculeata)

GÖRAN E. NILSSON

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The aculeate fauna (excluding Formicidae, Apidae s.str., Andrenidae, and Halictidae) was surveyed in the Ridö archipelago nature reserve (19 km²) and the small adjacent mainland area Solbacken (0.5 km²). The Ridö archipelago is characterized by a mosaic of deciduous forests (including some of nearly primeval type), coniferous forests, wet and dry meadows, grazing ground, grazing marshes, and parkland. During 1982–1990, a total of 1139 specimens were collected in the archipelago and more than 2000 specimens at Solbacken. 222 species (45 % of the Swedish fauna) are represented in the material (150 species from the archipelago). Of the species found, 35 occur on red data lists from Britain and/or Central Europe. The wood-nesting fauna was the richest. Wood-nesting sphecids were represented by 57 species (72 % of the wood-nesting Swedish fauna), a figure that outnumbers most Swedish provinces (including Skåne, Öland and Gotland) and equals the number of Danish species. Of wood-nesting eumenid wasps and megachilid bees, 63% and 81%, respectively, of all Swedish wood-nesting species were found. The richness of the wood-nesting aculeate fauna is probably related to the wealth of dead trees and fallen logs, the rich flora of flowering plants, the exceptionally mild and dry local climate, and a continuous influence from neighbouring populations. Five species are reported as new to Sweden, and 13 new province records are given.

G. E. Nilsson, Department of Zoophysiology, Uppsala University, P.O. Box 560, S-751 22 Uppsala, Sweden.

Introduction

In general, solitary and social wasps and bees represent two main types of nesting habits: (1) those who dig their nest in sand or soil, and (2) those who nest in cavities in other materials, mainly wood and plant stems. At least in northern Europe, these two ecological groups include similar numbers of species distributed among most major families.

Sphecidae, the most diverse aculeate family in Sweden, has 77 species in the first group and 79 in the second. The many aculeate species that are parasites on other aculeates are generally rather host-specific, and, thus, can be referred to the same ecological groups as their hosts.

All recent Swedish regional surveys of aculeate Hymenoptera have dealt with sandy areas dominated by soil nesting species. The present survey is the first study of an area with very few sandy biotopes but rich in woodland, notably old, more or less natural, deciduous forests. During the

course of this study, it soon became clear that the Ridö archipelago contains one of the richest faunas of wood and stem nesting aculeates in northern Europe.

Study area

The Ridö archipelago is a nature reserve situated in the western part of Lake Mälaren (59°30' N, 16°40' E). The main part belongs to the province Västmanland (VS), and a smaller part belongs to Södermanland (SÖ). It consists of 160 islands ranging in size from 7.5 km² (Ridön) to less than 100 m² (Fig. 1). The total area is about 19 km².

The area, which has been surveyed botanically by Kers (1978), contains a mosaic of deciduous forests, coniferous forests, wet and dry meadows, grazing ground, grazing marshes, and parkland. The deciduous forests are rich in oak, elm, lime, ash, maple and alder. Probably due to the difficulties of transporting logs to the mainland, parts of

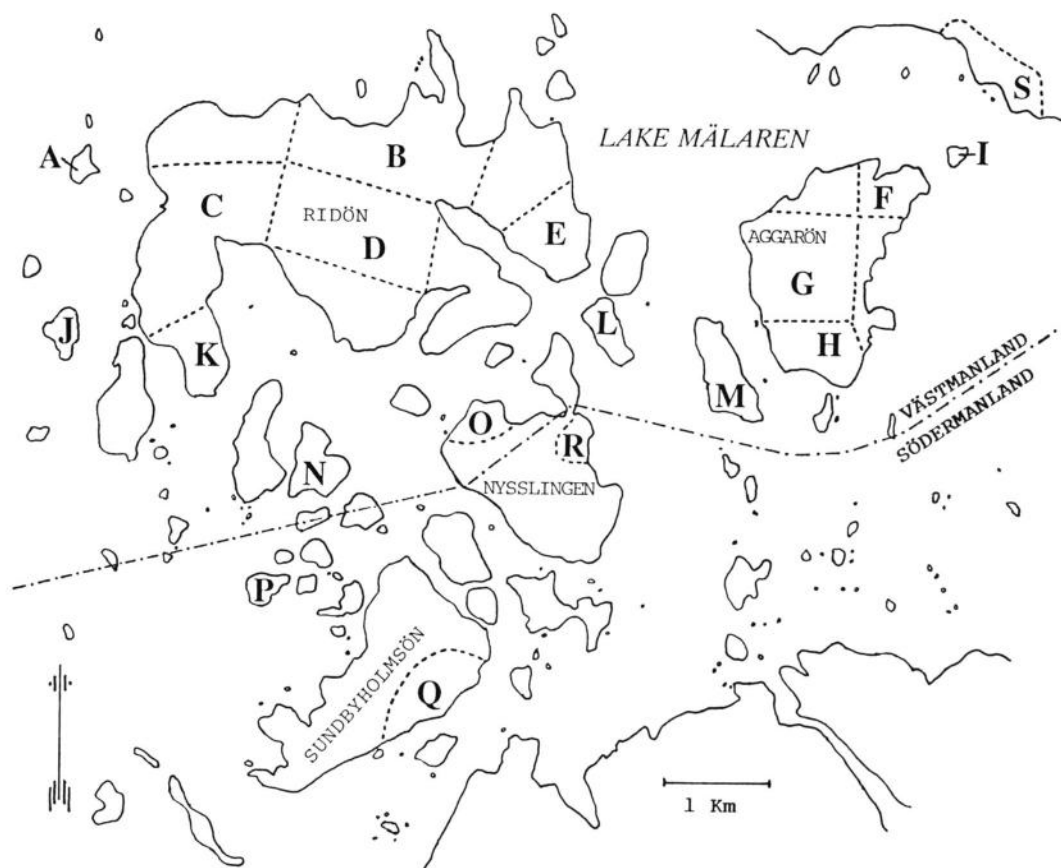


Fig. 1. Map of the Ridö archipelago. A = Flaten; B-E = Ridön; F-H = Aggarön; I = Lilla Aggarön; J = Högholmsskär; K = Svinholmen; L = Hemmingsskär; M = Aggarö Långholme; N = Grisslingen; O = Kurö-Nysslingen; P = Ekholmen; Q = Sundbyholmsön; R = Nysslingen; S = Solbacken.

Karta över Ridö-arkipelagen med använd områdesindelning.

the forests are in a nearly primeval state. There is a long history of pasturage (cattle) on the larger islands (Fig. 1: areas B-E, G-H, M, and Q), and the flora of open land is rich. The only noteworthy sandy biotope is an old sand pit (ca 1000 m²) on Flaten (Fig. 1: area A).

The climate of western Lake Mälaren is exceptional for its latitude, the mean summer temperature being among the highest (17°C in July) and the precipitation among the lowest in Sweden (Ångström 1974).

The deciduous forests of the Ridö archipelago hold a very rich wood-living beetle fauna including such rare species as *Mesosa curculionides* (L.), *Chlorophorus herbsti* (Brahm), and *Dicerca*

alni (Fischer v. Waldheim) (Lundberg 1963). The Lepidoptera fauna is also rich. For example, Ridön has the only known population of *Ethmia dodecea* (Haworth) in Fennoscandia (Palm 1989), a beautiful oecophorid moth living on *Lithospermum officinale*. Some notable aculeates from the Ridö archipelago were commented in Nilsson (1986).

Methods

All families of aculeate Hymenoptera were surveyed except ants (Formicidae), social bees (Apidae s.str.) and two families of solitary bees - Andrenidae and Halictidae. The latter two families

contain only sand and/or soil nesting species. Of the studied families, 489 species are known to occur in Sweden.

About 55 full-day collecting trips were made to the archipelago. Most specimens were collected with a hand-net at sites which appeared to be good habitats for aculeates, like logs, thatch, flowers and sun-exposed foliage. Ca 10 % of the material were collected in yellow pan traps and trap-nests.

Apart from the Ridö archipelago nature reserve (Fig. 1: areas A-R), also Solbacken (Fig. 1: area S) was included in the investigation. Solbacken is situated at the mainland shore (VS), only 500 m from the nearest island in the archipelago. I have a summer cottage at Solbacken, which has allowed an intensive collecting activity there since 1982. At Solbacken I have used netting, pan traps, trap-nests and Malaise traps. This area includes wet and dry meadows, and more or less natural deciduous forest, although not as old as some of the deciduous forest in the Ridö archipelago. In this paper, I only present those species from Solbacken that have not been recorded from the Ridö archipelago.

Abbreviations used for Swedish provinces (from south to north): SK=Skåne, BL=Blekinge, HA=Halland, SM=Småland, ÖL=Öland, GO=Gotland, GS=Gotska Sandön, ÖG=Östergötland, VG=Västergötland, BO=Bohuslän, DS=Dalsland, NÄ=Närke, SÖ=Södermanland, UP=Uppland, VS=Västmanland, VR=Värmland, DR=Dalarna, GÄ=Gästrikland, HS=Hälsingland, ME=Medelpad, HÄ=Härjedalen, JÄ=Jämtland, AN=Ångermanland, VB=Västerbotten, NB=Norrbotten, ÅS=Åsele lappmark, LY=Lycksele lappmark, PI=Pite lappmark, LU=Luleå lappmark, TO=Torne lappmark. The provincial division of Sweden is shown on a map in each volume of the series *Fauna Entomologica Scandinavica*.

Results

During the period 1982-1990, 1020 specimens were collected in the Ridö archipelago. In addition, Norén (1988) collected 119 specimens of the presently studied families. These are included in Tab. 1. The total number of species collected in the archipelago is 150 (Tab. 1). In addition, 72 species have been found within 200 m from the shore of the nearby mainland area Solbacken (Tab. 2), giving a total number of 222 species for areas A-S. This is 45.4 % of the Swedish fauna of the families studied, which must be considered a high number for such a small area.

With regard to wood-nesting species, the richness of the aculeate fauna of the Ridö archipelago

becomes even more impressive. After 9 years of collecting, the list of sphecids species from the Ridö archipelago (incl. Solbacken) contains the same number of wood-nesting species as has ever been recorded from Denmark (57 species according to Lomholdt 1976 and Pulawski 1984). Denmark is situated 250 - 600 km S of the archipelago, is more than 2000 times larger, has a direct continental connection, and, of course, contains a larger variety of biotopes. The comparatively high abundance of aculeate species in the Ridö archipelago is not due to an addition of northern elements. None of the species found in the archipelago has its southernmost Swedish record in VS, whereas 13 species have their northernmost known Swedish occurrence in VS. Indeed, all species found in the archipelago are also known from continental Europe.

Although all biotopes found at Solbacken appear to exist also in the Ridö archipelago (but not vice versa), the intensive study of Solbacken has yielded several aculeate species not found in the archipelago (Tab. 2). These species should be expected to occur also in the archipelago.

For each species listed in Tabs 1 and 2, the principal nesting habit is stated. However, the choice of nest substrate is not always constant for a certain species. For example, some usually ground-nesting species may occasionally nest in hollow plant stems, decayed wood or empty snail shells. This is true for species like *Agrenioideus cinctellus*, *Anoplius concinnus* and *A. nigerrimus* (Oehlke & Wolf 1987). Moreover, some chrysidid species that usually parasitize on wood-nesting aculeates may sometimes choose a ground living wasp as host.

In Sweden, the SE provinces have the richest wasp and bee fauna (e.g. Wolf 1969, Erlandsson 1971, Lomholdt 1974, 1976, Erlandsson et al. 1988, Svensson et al. 1990, Janzon et al. 1991). In Tab. 3, the eumenid, sphecids and megachilid faunas of the Ridö archipelago have been compared to those of the 10 south-eastern provinces. Especially of the wood-nesting species, Tab. 3 clearly shows that the Ridö archipelago holds an exceptionally rich fauna.

The wealth of wood-nesting aculeates in the Ridö archipelago is clearly exemplified by the Sphecidae. The sphecids fauna of areas A-S (72 % of the Swedish wood-nesting species) is only outnumbered by that of 4 Swedish provinces — SM, ÖG, UP and VS (Tab. 3). Indeed, the Ridö archi-

Tab. 1. List of species found in the Ridö archipelago. Areas (A-R) in which the species were found refer to Fig. 1. Inds. denotes the number of specimens collected; c means common and that additional individuals were observed. The months when each species were collected are listed. The nesting habitat is described as: (builder) builds nest with clay or wood mixed with saliva, and is relatively free in its choice of nesting site (thus, excl. *Vespa crabro*); (Col) parasite on Coleoptera larvae; (ground) nests in sand or soil; (Hom) parasite on Homoptera Auchenorrhyncha; (Lep) parasite on Lepidoptera larvae; (stems) nests in hollow plant stems, e.g. *Rubus* or *Phragmites*; (wood) nests in more or less decayed wood; (wo/st) nests in either wood or stems; (p) the species parasitizes on aculeates with the nesting habits given. Distribution gives the southern- and northernmost province records in Sweden and the total number of the 30 Swedish provinces from which records are known; (new) new to Sweden. The following families were not found (no. of Swedish species within parenthesis): Embolemidae (1), Tiphidae (3), Mutillidae (3), and Scoliidae (1).

Family and Species	Area	Inds.	Month	Nesting	Distribution
Bethylidae (13)					
<i>Bethylus nitidus</i> (Thomson)	F	1	7	Lep/Col	SK-VS(7)
<i>B. fuscicornis</i> (Jurine)	G	1	6	Lep/Col	SK-LU(24)
<i>Laelius femoralis</i> (Förster)	G	1	6	Col	SK-VS(6)
Chrysididae (46)					
<i>Omalus auratus</i> (L.)	AE	2	6-7	wo/st(p)	SK-LU(20)
<i>O. violaceus</i> (Scopoli)	C	1	7	wood(p)	SK-GÄ(5)
<i>Chrysura hirsuta</i> Gerstäcker	G	3	6	wood(p)	SM-LY(10)
<i>Chrysis viridula</i> L.	M	1	7	ground(p)	SK-GÄ(15)
<i>C. mediata</i> Linsenmaier	EM	2	6-7	wo/gr(p)	SK-NB(17)
<i>C. pseudobrevitarsis</i> Linsenmaier	F	1	6	wood(p)	SM-JÄ(9)
<i>C. impressa</i> Schenck	AEGHMNP	36	6-7	wood(p)	SK-TO(21)
<i>C. angustula</i> Schenck	EGN	11	6-8	wood(p)	SK-LY(23)
<i>C. longula</i> Abeille de Perrin	EGM	8	6-7	wood(p)	SK-LY(20)
<i>C. equestris</i> Dahlbom	CP	2	6-7	wood(p)	SM-HS(5)
<i>Trichrysis cyanea</i> (L.)	A-R	3c	6-7	wood(p)	SK-LY(25)
Dryinidae (22)					
<i>Anteon exiguum</i> Haupt	F	4	8	Hom	Unclear
<i>Lonchodryinus ruficornis</i> (Dalman)	F	1	8	Hom	SK-TO(7)
Sapygidae (3)					
<i>Sapyga clavicornis</i> (L.)	D	1	6	wood(p)	SK-HR(16)
<i>S. quinquepunctata</i> (F.)	C	1	6	wood(p)	SK-GÄ(9)
Pompilidae (63)					
<i>Priocnemis exaltata</i> (F.)	G	1	7	ground	SK-VB(19)
<i>Dipogon subintermedius</i> (Magr.)	EFGIJMN	18	6-8	wood	SK-HS(15)
<i>D. bifasciatus</i> (F.)	E	1	6	wood	SK-PI(18)
<i>Auplopus carbonarius</i> (Scopoli)	GM	9	7	builder	SK-GÄ(14)
<i>Arachnospila anceps</i> (Wesmael)	AN	7	8	ground	SK-VB(20)
<i>A. fumipennis</i> (Zetterstedt)	P	1	7	ground	SK-LU(16)
<i>A. spissa</i> (Schiödt)	A-Q	29c	6-8	ground	SK-VB(19)
<i>Agenioideus cinctellus</i> (Spinola)	AJM	4	7	ground	SK-LY(16)
<i>Anoplius concinnus</i> (Dahlbom)	A	4	7	ground	SK-LU(18)
<i>A. nigerrimus</i> (Scopoli)	AGP	11	6-7	ground	SK-LY(19)
<i>Episyron rufipes</i> (L.)	AP	12	7	ground	SK-VB(17)
Eumenidae (36)					
<i>Odynerus spinipes</i> (L.)	CG	2	6	ground	SK-NB(17)
<i>Gymnomerus laevipes</i> (Shuckard)					
ssp. <i>scandinavicus</i> (Saussure)	Q	1	7	stems	SK-HR(17)
<i>Ancistrocerus quadratus</i> (Panzer)	G	1	6	wo/st	SK-ME(18)
<i>A. trifasciatus</i> (Müller)	CEGP	13	6-7	wo/st	SK-LU(25)
<i>A. parietinus</i> (L.)	AEFGMNP	52	6-7	wood	SK-TO(20)
<i>A. antilope</i> (Panzer)	E	5	6	wood	SK-LY(17)
<i>A. oviventris</i> (Wesmael)	AGMN	16	6-7	wood	SK-LU(24)
<i>Symmorphus crassicornis</i> (Panzer)	EF	3	6-7	wood	SK-HS(12)
<i>S. gracilis</i> (Brullé)	ABCGM	15	6-8	wood	SK-LY(11)
<i>S. bifasciatus</i> (L.)					
(<i>mutinensis</i> auct.)	ACEFGM	11	6-8	wood	SK-LU(20)

Family and Species	Area	Inds.	Month	Nesting	Distribution
<i>S. debilitatus</i> (Saussure)	ABEFGMNO	39	6–7	wo/st	NÄ-GÄ(6)
<i>S. connexus</i> (Curtis)	CEFG	22	6–8	wood	HA-DR(6)
<i>S. allobrogus</i> (Saussure)					
(<i>bifasciatus</i> auct.)	CEGMN	19	7	wo/st	SK-TO(23)
<i>Euodynerus notatus</i> (Jurine)	M	1	7	wood	SK-VB(12)
<i>E. quadrfasciatus</i> (F.)	GMP	6	6–7	wood	SK-VB(17)
<i>Eumenes pedunculatus</i> (Panzer)	E	1	7	builder	SK-LU(19)
<i>E. coronatus</i> (Panzer)	ABEGM	10	6–8	builder	SK-HS(16)
<i>Discoelius zonalis</i> (Panzer)	AEGP	17	6–8	wood	SK-VS(6)
Vespidae (13)					
<i>Vespa crabro</i> L.	CEFG	2c	6–8	wood	SK-GÄ(12)
<i>Dolichovespula media</i> (Retzius)	EF	2	6–7	builder	SK-TO(28)
<i>D. norwegica</i> (F.)	E	1	6	builder	SK-TO(19)
<i>D. saxonica</i> (F.)	ADEGMP	9	6–7	builder	SK-TO(29)
<i>Vespula vulgaris</i> (L.)	E	1	6	builder	SK-TO(27)
<i>V. germanica</i> (F.)	F	1	7	builder	SK-LY(19)
<i>V. rufa</i> (L.)	CEHM	5	6–7	builder	SK-TO(29)
<i>V. austriaca</i> (Panzer)	E	1	6	builder(p)	SM-LU(18)
Sphecidae (156)					
<i>Ammophila sabulosa</i> (L.)	O	1	7	ground	SK-TO(26)
<i>Pemphredon lugubris</i> (F.)	CGP	41	6–7	wood	SK-TO(24)
<i>P. montanus</i> Dahlbom	G	2	7–8	wood	SK-LU(24)
<i>P. inornatus</i> Say	CFGP	21	6–7	wood	SK-LU(20)
<i>P. lethifer</i> Shuckard	D	1	6	wood	SK-GÄ(12)
<i>Ceratophorus morio</i> (v.d.Linden)	G	2	6–7	wood	SM-VB(12)
<i>C. clypealis</i> (Thomson)	G	3	6	wood	SK-VS(5)
<i>Passaloecus eremita</i> Kohl	G	1	6	wo/st	SM-JÄ(12)
<i>P. corniger</i> Shuckard	CEFGMN	20	6–8	wo/st	SK-HS(17)
<i>P. insignis</i> (v.d.Linden)	CGNP	7	6–7	wo/st	SK-DR(15)
<i>P. singularis</i> Dahlbom	CEFGHM	11	6–7	wo/st	SK-VB(16)
<i>Stigmus solskyi</i> Morawitz	CEGMP	22	6–8	wo/st	SK-HS(11)
<i>Spilomena enslini</i> Blüthgen	G	1	7	stems	SM-GÄ(8)
<i>S. troglodytes</i> (v.d.Linden)	EGM	7	6–8	wood	SK-HS(13)
<i>S. beata</i> Blüthgen	C	1	7	wo/st	VS(new)
<i>Minumesa dahlbomi</i> (Wesmael)	CGP	4	6–7	wood	SK-ÄS(17)
<i>M. beaumonti</i> (van Lith)	CGPQR	10	6–7	wood	ÖG-GÄ(5)
<i>Psenulus fuscipennis</i> (Dahlbom)	GMNP	13	6–7	wo/st	SK-GÄ(14)
<i>P. pallipes</i> (Panzer)	ACEGI	8	7	wo/st	SK-GÄ(15)
<i>Argogorytes mystaceus</i> (L.)	CH	4	7	ground	SK-ÄN(19)
<i>Gorytes laticinctus</i> (Lepeletier)	C	2	7	ground	SK-ME(14)
<i>Harpactus tumidus</i> (Panzer)	N	1	7	ground	SK-VB(16)
<i>Nysson spinosus</i> (Forster)	CE	4	6–7	ground(p)	SK-ME(17)
<i>Astata boops</i> (Schränk)	C	1	7	ground	SK-GÄ(17)
<i>Nitela spinolae</i> Latreille	EFG	4	6–8	wo/st	SK-DR(12)
<i>Trypoxylon clavicerum</i> Lepeletier	EFG	5	6–8	wo/st	SK-JÄ(14)
<i>T. attenuatum</i> Smith	CG	6	6–7	stems	SK-GÄ(14)
<i>T. figulus</i> (L.)	CGMNP	12	7–8	wo/st	SK-DR(8)
<i>T. minus</i> de Beaumont	CFGP	12	7	wo/st	SK-VB(14)
<i>Oxybelus uniglumis</i> (L.)	ACD	7	6–7	ground	SK-NB(24)
<i>Ectemnius cephalotes</i> (Olivier)	EFG	8	6–7	wood	SK-GÄ(14)
<i>E. cavifrons</i> (Thomson)	ACEGIP	23	6–7	wood	SK-GÄ(15)
<i>E. ruficornis</i> (Zetterstedt)	FG	2	6–8	wood	SK-TO(25)
<i>E. lapidarius</i> (Panzer)	B	1	7	wood	SK-VB(20)
<i>E. continuus</i> (F.)	CEFM	11	6–7	wood	SK-TO(25)
<i>E. dives</i> (Lepeletier & Brullé)	CDE	7	6–7	wood	SK-GÄ(15)
<i>Lestica clypeata</i> (Schreber)	G	2	6	wood	SK-GÄ(7)
<i>Entomognathus brevis</i> (v.d.Linden)	CDG	4	7	ground	SK-DR(15)
<i>Lindenius albilabris</i> (F.)	C	1	7	ground	SK-NB(21)
<i>Rhopalum clavipes</i> (L.)	GI	3	7–8	wo/st	SK-VB(19)
<i>R. coarctatum</i> (Scopoli)	AEFGHM	31	6–8	wo/st	SK-LU(19)
<i>R. nigrinum</i> (Kiesenwetter)	C	1	7	stems	SK-VS(5)

Family and Species	Area	Inds.	Month	Nesting	Distribution
<i>Crossocerus quadrimaculatus</i> (F.)	C	6	7	ground	SK-GÄ(13)
<i>C. podagricus</i> (v.d.Linden)	ABEFGMR	35	6–8	wood	SK-VS(10)
<i>C. congener</i> (Dahlbom)	EG	4	6–8	wood	ÖG,UP,VS
<i>C. walkeri</i> (Shuckard)	EFGMP	13	6–8	wood	SK-GÄ(9)
<i>C. annulipes</i> (Lepeletier & Brullé)	CEGM	29	6–8	wood	SK-GÄ(9)
<i>C. heydeni</i> Kohl	G	3	6–8	wood	ÖG-DR(6)
<i>C. barbipes</i> (Dahlbom)	G	2	6	wood	BL-VB(9)
<i>C. leucostomus</i> (L.)	CG	4	6	wood	SK-TO(26)
<i>C. cetratus</i> (Shuckard)	CEFG	9	6–7	wood	SK-GÄ(12)
<i>C. megacephalus</i> (Rossi)	G	1	6	wood	SK-NB(18)
<i>C. vagabundus</i> (Panzer)	GMP	7	6–7	wood	SK-ÄN(16)
<i>C. dimidiatus</i> (F.)	E	1	6	wood	SK-LU(20)
<i>C. binotatus</i> Lepeletier & Brullé	G	1	7	wood	HA-VS(6)
Colletidae (25)					
<i>Colletes davesianus</i> Smith	MN	5	7	ground	SK-NB(23)
<i>Hylaeus communis</i> Nylander	A–Q	37c	6–8	wo/st	SK-TO(27)
<i>H. angustatus</i> (Schenck)	D	1	7	wo/st	SK-ME(19)
<i>H. confusus</i> Nylander	ACDFGHMQ	20	6–7	wo/st	SK-VB(23)
<i>H. gibbus</i> Saunders	D	1	7	wo/st	SK-ME(16)
<i>H. difformis</i> (Eversmann)	CM	8	7	wo/st	SK-DR(12)
<i>H. rinki</i> (Gorski)	CQ	2	7	stems	BL-JÄ(14)
Melittidae (8)					
<i>Melitta haemorrhoidalis</i> (F.)	D	1	7	ground	SK-VR(15)
<i>Macropis labiata</i> (F.)	CDEG	7	7	ground	SK-GÄ(16)
Megachilidae (51)					
<i>Stelis breviscula</i> (Nylander)	N	2	7	wood(p)	SK-ME(13)
<i>S. ornatula</i> (Klug)	EG	3	6–7	wood(p)	SK-GÄ(13)
<i>Heriades truncorum</i> (L.)	CFGNQ	11	6–7	wood	SK-ME(17)
<i>Chelostoma florissomne</i> (L.)	CEG	21	6–7	wood	SK-ME(14)
<i>C. campanularum</i> (Kirby)	CGMN	9	6–7	wood	SK-VB(20)
<i>Osmia pilicornis</i> Smith	C	1	6	wood	SK-VS(7)
<i>O. uncinata</i> Gerstäcker	C	5	6	wood	SK-TO(16)
<i>O. parietina</i> Curtis	G	1	6	wood	SM-TO(18)
<i>O. leaiana</i> (Kirby)	CEM	10	6–7	wood	SK-NB(14)
<i>O. caerulea</i> (L.)	C	1	6	wood	SK-ÄN(19)
<i>Hoplitis tuberculata</i> (Nylander)	CFG	10	6–7	wood	SK-NB(16)
<i>H. claviventris</i> Thomson	CDEGKMQ	12	6–7	stems	SK-LY(22)
<i>H. leucomelana</i> (Kirby)	GQ	4	6–7	stems	SK-GÄ(10)
<i>Megachile ligniseca</i> (Kirby)	BCEFGMP	12	6–7	wood	SM-GÄ(9)
<i>M. centuncularis</i> (L.)	CFM	5	7–8	wo/st	SK-HS(15)
<i>M. alpicola</i> Alfken	CDGMQ	12	6–8	wood	SK-VB(14)
<i>M. versicolor</i> Smith	CDGM	6	7–8	wo/st	SK-VB(14)
<i>M. willughbiella</i> (Kirby)	CP	6	6–7	wood	SK-VB(22)
<i>M. circumcineta</i> (Kirby)	C	1	6	ground	SK-LU(22)
<i>M. nigriventris</i> Schenck	GQ	8	6–7	wood	SM-LU(17)
<i>Anthidium punctatum</i> Latreille	G	1	6	ground	SK-ÄN(19)
<i>Coelioxys rufescens</i> Lepeletier	BC	4	7	wood(p)	SK-ÄN(19)
<i>C. elongata</i> Lepeletier	G	2	6–7	wood(p)	SK-VS(13)
<i>C. inermis</i> (Kirby)	G	3	6	wood(p)	SK-NB(16)
Anthophoridae (44)					
<i>Anthophora furcata</i> (Panzer)	BCEFG	13	6–8	wood	SK-VB(19)
<i>Nomada bifida</i> Thomson	E	1	6	ground(p)	SK-LU(13)
<i>N. leucophthalma</i> (Kirby)	FG	3	5	ground(p)	SK-VB(12)
<i>N. marshalli</i> (Kirby)	CD	3	6	ground(p)	SK-GÄ(14)
<i>N. flavoguttata</i> (Kirby)	G	1	6	ground(p)	SK-JÄ(17)
<i>N. fabriciana</i> (L.)	CD	9	7	ground(p)	SK-VS(8)
<i>Epeolus variegatus</i> (L.)	C	1	7	ground(p)	SK-DR(8)

pelago contains more wood-nesting sphecoid species than the Baltic islands Öland and Gotland, as well as Skåne, the southernmost Swedish province. These three provinces have all been relatively thoroughly investigated with regard to aculeates.

The fauna of wood-nesting megachilid bees in the Ridö archipelago is also very rich, only outnumbered by 4 Swedish provinces, whereas the wood-nesting eumenid fauna is somewhat less impressive when compared to that of whole provinces (Tab. 3).

The following 5 species are here reported as new to Sweden: *Aphelopus querceus*, *A. nigriceps*, *A. serratus*, *Anteon tripartitum*, and *Spilomena beata* (dryinids determined by M. Olmi). *Symmorphus debilitatus* is reported from SÖ for the first time. The following 12 species are new to VS: *Embolemus ruddi*, *Goniozus claripennis*, *Bethylus fuscicornis*, *Aphelopus melaleucus*, *Anteon flavicorne*, *A. pubicorne*, *A. fulviventre*, *A. jurineanum*, *Mesodryinus niger*, *Spilomena expectata*, *Lestica clypeata*, and *Rhopalum nigrinum*.

Discussion

A combination of several favourable factors are seemingly responsible for the high diversity of wood-nesting aculeates in the Ridö archipelago. A key factor must be the mosaic of small forests with many dead and dying trees (deciduous and coniferous) mixed with grazing grounds, marshes and other sites rich in herbs. This mosaic provides a wealth of both nesting substrates and nutritional resources. Pollen and nectar are the main energy sources for adult aculeates and for the larvae of bees. Another essential factor is probably the exceptionally warm climate in the western part of Lake Mälaren, with hot summers, comparatively mild winters, and low precipitation. Finally, the presence of several similar areas (notably Tidö, Strömsholm, and Ängsö) within 20 km from the archipelago is likely to be of importance. Modern theories on metapopulations predict that the presence of many small populations within a limited geographic area will improve the chance for survival of a species during periods of unfavourable conditions (Gilpin 1987). Thus, in the long run, neighbouring populations may very well be essential for preserving a diverse fauna in the Ridö archipelago.

Threatened species in the Ridö archipelago

Unfortunately, the red data list for aculeates in Sweden (Andersson et al. 1987) is still rudimentary (except for ants). Hence, I will here refer to the more comprehensive lists issued for Britain (Shirt 1987), Germany (Blab et al. 1984), Austria (Gepp 1984), and Baden-Württemberg (Westrich & Schmidt 1984, Westrich 1989). Those for Baden-Württemberg are especially valuable because detailed background data have been published (Schmidt 1979-1983, Westrich 1989).

Tab. 4 lists the 35 species from the Ridö archipelago (incl. Solbacken) that are included on European lists over threatened species. The high number of endangered species shows that the Ridö archipelago is well worth its protection also in an international perspective. Although environmental destruction is somewhat less severe in Fennoscandia than in the more densely populated parts of Europe, one may assume that the wasps and bees that are threatened in other parts of Europe are potentially endangered also in Fennoscandia. As almost all aculeates in Fennoscandia exist near their northern distributional limits, they should be especially vulnerable to environmental change. Thus, the thermophilic nature of most aculeates will put additional demands on the micro-climate and the degree of sun exposure of their nesting sites in Fennoscandia as compared to continental Europe.

Comments on selected species

Symmorphus debilitatus is here recorded from SÖ for the first time. It appears to be very rare within its entire distributional range (Blüthgen 1961), and has a scattered occurrence in northern and central continental Europe (Cumming 1989). In the Ridö archipelago, it was found nesting in large numbers in eaves of thatched roofs (*Phragmites*) on old cottages and barns. I have also seen it nesting in beetle-tunnels in logs of old deciduous trees, especially oak. It also nests in maple (L.-Å. Janson in litt.) The only other sites where I have found *debilitatus* are Tidö in VS, and Biskops-Armö and Kungshamn (S of Uppsala) in UP, i.e. areas still rich in old deciduous trees. Needless to say, thatched cottages, and deciduous forests rich in dead and dying trees, are decreasing in number or area. *S. debilitatus* has been found to prey on larvae of a small oak leaf-mining moth

Tab. 2. List of species found at Solbacken (area S) but hitherto not recorded from the Ridö archipelago. See legend to Tab. 1 for explanations.

Family and Species	Inds.	Month	Nesting	Distribution
Embolemyidae				
<i>Embolemyus ruddii</i> Westwood	1	10	unknown	SK-ME(7)
Bethylidae				
<i>Goniozus claripennis</i> (Förster)	5	6–8	Lep	SK-ÅN(13)
Chrysididae				
<i>Omalus aeneus</i> (F.)	2	7	wood(p)	SM-ME(7)
<i>Hedychrum niemelai</i> Linsenmaier	2	6–7	ground(p)	SK-GÄ(13)
<i>Chrysis bicolor</i> Lepeletier	1	7	ground(p)	ÖL,UP,VS
<i>C. fulgida</i> L.	11	5–7	wood(p)	SK-ÅN(18)
<i>C. mediadentata</i> Linsenmaier	1	6	wood(p)	SK-LY(16)
<i>C. schencki</i> Linsenmaier	2	6–7	wood(p)	SK-LY(13)
Dryinidae				
<i>Aphelopus melaleucus</i> (Dalman)	3	5–6	Hom	SK-LU(4)
<i>A. querceus</i> Olmi	7	6–8	Hom	VS(new)
<i>A. nigriceps</i> Kieffer	1	7	Hom	VS(new)
<i>A. serratus</i> Richards	4	6–7	Hom	VS(new)
<i>Anteon flavicornis</i> (Dalman)	2	6–7	Hom	VG,VS(2)
<i>A. pubicornis</i> (Dalman)	8	6–8	Hom	SK-TO(7)
<i>A. tripartitum</i> Kieffer	1	5	Hom	VS(new)
<i>A. gaullei</i> Kieffer	1	8	Hom	SK-VS(4)
<i>A. fulviventre</i> (Haliday)	10	6–7	Hom	UP,VS
<i>A. jurineanum</i> Latreille	5	6–7	Hom	SK-VS(4)
<i>Mesodryinus niger</i> (Kieffer)	1	7	Hom	VS,VR
Sapygidae				
<i>Sapyga similis</i> (F.)	8	5–6	wood(p)	SM-LU(14)
Mutillidae				
<i>Myrmica atra</i> Panzer	19	6–8	ground	SK-VB(12)
<i>Smicromyrme rufipes</i> (F.)	3	6–7	ground	SK-HS(17)
Pompilidae				
<i>Priocnemis perturbator</i> (Harris)	7	4–6	ground	SK-LU(18)
<i>P. pusilla</i> Schiödte	1	7	ground	SK-VR(11)
<i>P. schioedtei</i> Haupt	10	7–8	ground	SK-HS(16)
<i>P. cordivalvata</i> Haupt	66	7–8	ground	SK-NB(11)
<i>P. hyalinata</i> (F.)	39	7–8	ground	SK-GÄ(15)
<i>P. fennica</i> Haupt	2	6–8	ground	SK-VB(13)
<i>Calidurgus fasciatellus</i> (Spinola)	2	7	ground	SK-GÄ(13)
<i>Dipogon variegatus</i> (L.)	27	6–8	wood	SK-GÄ(16)
<i>Arachnospila rufa</i> (Haupt)	1	6	ground	SK-HS(13)
<i>Anoplius viaticus</i> (L.)	1	5	ground	SK-ÅN(19)
Eumenidae				
<i>Ancistrocerus nigricornis</i> (Curtis)	6	5–8	wood	SK-LY(15)
<i>Symmorphus murarius</i> (L.)	4	6–7	wood	SK-GÄ(8)
Sphecidae				
<i>Dolichurus corniculatus</i> (Spinola)	20	6–8	ground	SK-VB(18)
<i>Pemphredon lugens</i> Dahlbom	30	5–6	wood	SK-NB(18)
<i>Diodontus medius</i> Dahlbom	12	6–7	ground	SM-LU(16)
<i>Passaloecus gracilis</i> (Curtis)	1	7	wo/st	SK-VS(13)
<i>P. turionum</i> Dahlbom	1	7	wood	SK-LU(16)
<i>P. borealis</i> Dahlbom	8	5–7	wood	SM-LY(10)
<i>Spilomena differens</i> Blüthgen	2	7	wood	SK-VB(16)
<i>S. expectata</i> Valkeila	1	7	stems	SK-GÄ(11)
<i>Psenulus concolor</i> (Dahlbom)	14	6–7	wo/st	SK-GÄ(12)
<i>P. schencki</i> (Tournier)	2	7	wood	ÖL-GÄ(9)
<i>Cerceris arenaria</i> (L.)	6	7–8	ground	SK-ME(20)
<i>C. quadrifasciata</i> (Panzer)	3	7	ground	SK-LU(15)

Family and Species	Inds.	Month	Nesting	Distribution
<i>Argogorytes fargei</i> (Shuckard)	1	7	ground	SK-LU(22)
<i>Gorytes quadrifasciatus</i> (F.)	1	7	ground	SK-NB(18)
<i>Nysson trimaculatus</i> (Rossi)	18	7-8	ground(p)	SK-GÄ(14)
<i>N. dimidiatus</i> Jurine	1	7	ground(p)	SK-ÅN(12)
<i>Mellinus arvensis</i> (L.)	10	7-8	ground	SK-ME(20)
<i>Astata pinguis</i> (Dahlbom)	1	6	ground	SK-LU(20)
<i>Tachysphex obscuripennis</i> (Schenck)	1	7	ground	SK-VR(14)
<i>T. pompiliiformis</i> (Panzer)	5	7-8	ground	SK-NB(21)
<i>Nitela borealis</i> Valkeila	2	7	wo/st	SK-VB(15)
<i>Crabro cribrarius</i> (L.)	19	7-8	ground	SK-VB(23)
<i>Ectemnius rubicola</i> (Duf. & Perris)	3	6-7	stems	SM-ME(10)
<i>E. guttatus</i> (v.d.Linden)	8	5-7	wood	SK-VB(15)
<i>E. borealis</i> (Zetterstedt)	2	5-6	wood	SK-TO(27)
<i>Crossocerus ovalis</i> Lep. & Brullé	6	6-8	ground	SK-TO(18)
<i>C. pusillus</i> Lepeletier & Brullé	5	7	ground	SK-VB(17)
Colletidae				
<i>Hylaeus brevicornis</i> Nylander	4	7-8	wo/st	SK-JÄ(18)
<i>H. annulatus</i> (L.)	3	6-7	wo/st	SK-TO(27)
<i>H. hyalinatus</i> Smith	19	6-8	wo/st	SK-ÅN(20)
Megachilidae				
<i>Anthidium manicatum</i> (L.)	2	7	ground	SK-JÄ(19)
<i>Stelis punctulatissima</i> (Kirby)	1	7	wood(p)	SK-HS(16)
<i>Osmia rufa</i> (L.)	3	5	wood	SK-GÄ(13)
<i>Megachile lapponica</i> Thomson	1	7	wood	SM-TO(10)
<i>Coelioxys lanceolata</i> Nylander	1	6	wood(p)	SM-LY(7)
Anthophoridae				
<i>Anthophora quadrimaculata</i> (Panzer)	1	7	ground	SK-ÅS(23)
<i>Nomada obscura</i> Zetterstedt	17	4-6	ground(p)	SK-LU(14)
<i>N. roberjeotiana</i> Panzer	5	7	ground(p)	SK-LU(21)

[*Tischeria complanella* (Hübner)] in France (Blüthgen 1961). However, Van Lith (1964), who gave a detailed account of the nesting of *debilitatus* in the thatch of an old barn in Ulvenhout (Holland), found that it can use several species of Microlepidoptera as larval provision. Nevertheless, if *debilitatus* is relatively fastidious in its choice of prey and nesting site, this may contribute to its rarity, and *debilitatus* should probably be regarded as endangered or vulnerable in Sweden. Indeed, *debilitatus* is regarded as potentially endangered in northern Germany (Haeseler 1978). On Ridön (area B), one *debilitatus* female was found visiting flowers of *Heracleum sphondylium*; literature records of flower visits of this species are unknown to me.

Symmorphus connexus is rare in Sweden (recorded from HA, ÖL, SÖ, UP, VS, and DR), and in the rest of its distribution area (Blüthgen 1961). It has a geographic range similar to that of *S. debilitatus* (Cumming 1989), although it extends further to the west (southern England) and east (Altai, USSR). I have seen it nesting in deciduous

logs in the Ridö archipelago and in some other sites rich in deciduous forest and close to the western part of Lake Mälaren. Unlike *S. debilitatus* and *S. allobrogus*, I have hitherto not found *connexus* nesting in thatch. However, Jørgensen (1942) found *connexus* nesting in a thatched roof in northern Sjaelland, Denmark. He observed that *connexus* preyed upon leaf mining larvae of *Zeugophora subspinosus* (Fabricius) (Col., Chrysomelidae) and *Caloptilia stigmatella* (Fabricius) (Lep., Gracillariidae) in leaves of *Populus tremula*. Thus, *connexus* seems to depend on deciduous trees for larval provision and is probably favoured by an abundance of dead wood and logs for nesting. It should probably be regarded as vulnerable in Sweden.

Symmorphus murarius is rare in Sweden and in the rest of its distribution area (Blüthgen 1961); i.e. southern Scandinavia and continental Europe eastwards through USSR to the Pacific Ocean (Cumming 1989). *S. murarius* is regarded as threatened in Germany (Blab et al. 1984). The 4 females collected at Solbacken were found flying

near barkless logs of oak, probably in search for a suitable nesting substrate. *S. murarius* nests in beetle tunnels in wood, in thatch and in holes in stone walls, and uses larvae of *Chrysomela populi* L. (Col., Chrysomelidae) that lives on *Populus tremula*, as larval provision.

Discoelius zonalis is abundant in at least 4 areas in the Ridö archipelago, all with deciduous forests of primeval type and rich in lime-trees, viz. Flaten (area A), Österängen on Ridön (area E), 300 m SW Lindsbo on Aggarön (area G) and Ekholmen (area P). On Flaten and Ekholmen, I have regularly observed males of *zonalis* patrolling the sun-exposed foliage of lime-trees bordering glades in the forest. On two occasions, I have seen females nesting in sun-exposed barkless hard dry wood of lime-trees. In contrast to other Swedish eumenids, the genus *Discoelius* covers the internal wall of the nest with leaves, not unlike the leaf-cutting bees (*Megachile*) (see Blüthgen 1961). *D. zonalis* is rare in Sweden (only recorded from 6 provinces) and in the rest of Europe (Blüthgen 1961). The Ridö archipelago is at the northern limit of the range of *zonalis*. Its high abundance in this area indicates that it is strongly favoured by a richness of dead deciduous trees.

Vespa crabro, the Hornet, has probably its northernmost viable population in Scandinavia in the Ridö archipelago (Pekkarinen 1989). From 1975 to 1986, I have seen the Hornet regularly in the area. During 1979 and 1980 it even nested in the attic of my summer cottage at Solbacken. Between 1982 and 1986, I saw the species on virtually every visit to Ridön (especially area C, D, E) and Aggarön. Unfortunately, since the exceptionally cold and rainy summer of 1987, I have not seen any Hornets in the archipelago. However, I have not specifically searched for it, or asked for it, and I hope that the population was strong enough to recover. Nevertheless, it is evident that the Hornet is declining in northern Europe (Pekkarinen 1989). Apart from being thermophilic, the Hornet prefers big hollow deciduous trees for nesting. Thus, like in Germany (Blab et al. 1984, Westrich & Schmidt 1985), *V. crabro* is endangered in Sweden.

Ceratophorus clypealis is known from 5 southern Swedish provinces north to VS. It nests in insect tunnels in dead and decaying wood, and is considered to be relatively thermophilic (Jacobs & Oehlke 1990). In Austria, it is regarded as endangered (Gepp 1984).

Spilomena beata is here recorded from Sweden for the first time. The single male collected was found at Västeräng on Ridön, 1.VII.90, on a thatched roof of a barn. The species is known from Finland, south and central Europe, and England (Dollfuss 1986, Vikberg 1986). Due to its small size (2.5–3.0 mm), it may have been overlooked. However, as all congeners are of this small size, *beata* is probably considerably less abundant than most other Swedish *Spilomena* species.

Mimusesa beaumonti is relatively anonymous in the literature. Of the 10 females caught in the Ridö archipelago, 6 were found flying on damp meadows or grazing marshes, 10–50 m from the *Phragmites* zone of the shore. Apparently, these females were searching for prey, probably small cicadas, the general larval provision of *Mimusesa* (Lomholdt 1976). Unfortunately, no females were caught with prey. The 4 other specimens collected were found flying near sun-exposed dry barkless deciduous logs on relatively dry meadows, 50–200 m from the shore. Thus, such sun-exposed logs are probably the preferred nesting site.

Records of *beaumonti* from Schleswig-Holstein (N Germany) are from similar biotopes: a shore with *Phragmites* (Haeseler 1984) and a regularly flooded area with plenty of dead deciduous trees (*Betula*) (Haeseler 1985).

Apart from the individuals of *beaumonti* collected in the Ridö archipelago (areas A–R), I have also collected one female at Solbacken in *Sium latifolium* flowers surrounded by *Phragmites* on the shore of Lake Mälaren. *M. beaumonti* seems to be very rare all over Europe. In Sweden, it has only been recorded from 5 central provinces (ÖG, NÄ, UP, VS, and GÄ). The only other recent Swedish record known to me is from Båtfors on the shore of the island Storön in River Dalälven (1♀ 29.VII.76 leg. B. Cederberg), northern UP (new to UP). Storön and surrounding islands show many similarities to the Ridö archipelago, including an extraordinary richness of very old and dying deciduous trees.

Lestica clypeata is very rare in Fennoscandia and Denmark (Lomholdt 1976). However, apart from one specimen of each sex collected near Lindsbo on Aggarön 25.VI.90, I have recently found *clypeata* at Rytterne near Strömsholm (VS) and at Örsundsbro (UP). Thus, it is possible that the species is more common in central Sweden than in the rest of northern Europe. It nests in decayed wood and should probably be regarded

Tab. 3. Species richness of Eumenidae, Sphecidae and Megachilidae in Sweden, in each of the south-eastern provinces, and in the Ridö archipelago. Percentage values refer to the number of species recorded from Sweden.

Family and Area	Total no. of species	No. of species nesting in:	
		Wood/stems	Ground/builder
Eumenidae			
Sweden	36(100%)	27(100%)	9(100%)
Ridö archipelago			
Areas A-R	18(50%)	15(56%)	3(33%)
Areas A-S	20(56%)	17(63%)	3(33%)
Swedish provinces			
Skåne	28(78%)	22(81%)	6(66%)
Blekinge	13(36%)	9(33%)	4(44%)
Småland	29(81%)	23(85%)	6(66%)
Öland	29(81%)	23(85%)	6(66%)
Gotland	22(61%)	17(63%)	5(55%)
Östergötland	26(72%)	21(78%)	5(55%)
Närke	21(58%)	16(59%)	5(55%)
Södermanland	28(78%)	22(81%)	6(66%)
Uppland	31(86%)	25(93%)	6(66%)
Västmanland	25(69%)	21(78%)	4(44%)
Sphecidae			
Sweden	156(100%)	79(100%)	77(100%)
Ridö archipelago			
Area A-R	55(35%)	45(57%)	10(13%)
Area A-S	82(53%)	57(72%)	25(32%)
Swedish provinces			
Skåne	119(76%)	55(70%)	64(84%)
Blekinge	69(44%)	33(42%)	36(47%)
Småland	118(76%)	62(78%)	56(73%)
Öland	112(72%)	52(66%)	60(78%)
Gotland	96(62%)	44(56%)	53(69%)
Östergötland	116(74%)	65(82%)	51(66%)
Närke	91(58%)	48(61%)	43(56%)
Södermanland	100(64%)	54(68%)	46(60%)
Uppland	116(74%)	67(85%)	49(64%)
Västmanland	99(63%)	63(80%)	36(47%)
Megachilidae			
Sweden	51(100%)	32(100%)	19(100%)
Ridö archipelago			
Area A-R	24(47%)	22(69%)	2(11%)
Area A-S	29(57%)	26(81%)	3(16%)
Swedish provinces			
Skåne	39(76%)	25(78%)	14(74%)
Blekinge	23(45%)	14(44%)	9(47%)
Småland	41(80%)	30(94%)	11(58%)
Öland	37(72%)	22(69%)	15(79%)
Gotland	32(63%)	22(69%)	10(53%)
Östergötland	43(84%)	31(97%)	12(63%)
Närke	15(29%)	11(34%)	4(21%)
Södermanland	39(76%)	30(94%)	9(47%)
Uppland	40(78%)	29(91%)	11(58%)
Västmanland	32(63%)	26(81%)	6(32%)

as thermophilic, being common in the Mediterranean area.

Rhopalum nigrinum. The single female hitherto collected in the archipelago was netted in the *Phragmites* zone at Tegelviken on Ridön

1.VII.90. *R. nigrinum* occurs mainly near fresh or brackish water, where it has been found nesting in *Phragmites* (Lomholdt 1976). This apparently sporadic species is in Sweden known from 5 provinces, VS being the northernmost.

Tab. 4. Species of Aculeata from the Ridö archipelago (areas A-R) and Solbacken (area S) that are included on European red data lists: (D) Germany, Blab et al. (1984); (BW) Baden-Württemberg, Westrich & Schmidt (1984) & Westrich (1989); (GB) Great Britain, Shirt (1987); (A) Austria, Gepp (1984). The following categories are used: (1) on the edge of extinction; (2) endangered, referred to as category 2–3 on continental lists; (3) potentially endangered or vulnerable, referred to as category 2 on the British list and category 4 on continental lists; (–) family not covered by list, or species not recorded from area.

Species	D	BW	GB	A
<i>Chrysura hirsuta</i>	–	–	3	–
<i>Chrysis fulgida</i>	–	–	1	–
<i>Sapyga similis</i>	–	2	–	–
<i>Arachnospila fumipennis</i>	2	–	–	–
<i>A. rufa</i>	2	2	1	–
<i>Symmorphus murarius</i>	2	–	–	–
<i>Odynerus spinipes</i>	2	2	–	–
<i>Eumenes pedunculatus</i>	2	–	–	–
<i>Discoelius zonalis</i>	–	2	–	–
<i>Vespa crabro</i>	2	2	–	–
<i>Dolichovespula media</i>	2	2	–	–
<i>Ceratophorus morio</i>	–	–	–	3
<i>C. clypealis</i>	–	–	–	3
<i>Passaloeus eremita</i>	–	–	–	3
<i>Argogorytes fargeii</i>	2	2	–	2
<i>Crossocerus walkeri</i>	2	2	–	–
<i>C. congener</i>	–	3	–	–
<i>C. heydeni</i>	–	3	–	–
<i>C. vagabundus</i>	–	–	1	–
<i>H. angustatus</i>	2	–	–	–
<i>H. difformis</i>	2	3	–	–
<i>Stelis breviscula</i>	–	–	1	–
<i>Osmia pilicornis</i>	–	3	–	–
<i>O. uncinata</i>	–	–	3	–
<i>O. leaiana</i>	–	2	–	–
<i>Megachile ligniseca</i>	–	3	–	–
<i>M. circumcincta</i>	–	2	–	–
<i>M. alpicola</i>	–	3	–	–
<i>M. nigriventris</i>	–	2	–	–
<i>Coelioxys rufecens</i>	2	1	–	–
<i>C. lanceolata</i>	1	–	–	–
<i>Nomada leucophthalma</i>	–	2	–	–
<i>N. obscura</i>	–	3	–	–
<i>N. roberjeotiana</i>	–	3	–	–
<i>Epeolus variegatus</i>	–	2	–	–

Crossocerus congener is one of the rarest species of the genus in Sweden; only known from ÖG, UP and VS. It has a sporadic occurrence in Europe, and it is regarded as potentially endangered in Baden-Württemberg (Westrich & Schmidt 1985). It has been found nesting in wood in Sweden and Germany (Kjellander 1954, Schmidt 1980) while Japanese individuals (ssp. *fukuiensis* Tsuneki) apparently nest in hollow plant stems (Tsuneki 1960). The specimens found

in the Ridö archipelago (4♀ 23.VI–9.VIII. Lindsbo on Aggarön and Österängen on Ridön) were all flying near decayed deciduous wood within forests. I have also found *congener* in a very similar biotope at Broholmen near Strömsholm, VS (1♀ 27.VII.90). Hence, *congener* seems to differ from most other *Crossocerus* species by preferring a shady habitat, and it might be associated with natural or primeval deciduous forests.

Crossocerus walkeri is common in the Ridö archipelago and at Solbacken but elsewhere rare. It nests in decayed wood (e.g. alder, oak and ash) near water and uses Ephemeroptera as larval provision (Schmidt 1980). Due to water pollution and the removal of dead wood near water, *walkeri* is regarded as endangered ("stark gefährdet") in Germany (Schmidt 1980, Blab et al. 1984, Westrich & Schmidt 1985). It is distributed from southern Fennoscandia and Central Europe eastwards to Japan.

Crossocerus heydeni is like *C. congener* a wood-nesting species that is rare in Sweden and in the rest of Europe (Lomholdt 1976, Schmidt 1980). This boreoalpine species is regarded as potentially endangered in Baden-Württemberg (Westrich & Schmidt 1985). The specimens collected in the Ridö archipelago (1♀ 2♂) were found on decayed deciduous logs in a similar (or even the same) shady habitat as that of *congener*.

Crossocerus binotatus is rare and has a scattered occurrence in Sweden, north to the Ridö archipelago. It is known to nest in old timber and logs. The single female collected in the archipelago (28.VII.85, near Lindsbo on Aggarön) was found flying near decayed deciduous logs inside a deciduous forest.

Megachile ligniseca is rare, and has a scattered occurrence in northern, central and eastern Europe. This big leafcutting bee nests in dead wood, e.g. in tunnels of *Cossus cossus* (L.), and is regarded as a forest species (Westrich 1989). Although *ligniseca* is generally very rare in Sweden, it is common in the Ridö archipelago, suggesting that it is favoured by an abundance of dead deciduous wood. It is regarded as potentially endangered in Baden-Württemberg (Westrich 1989), and, because of the disappearance of natural forests, *ligniseca* should probably be given the same status in Sweden.

Coelioxys lanceolata is probably the rarest species of its genus in Europe (Westrich 1989). This boreoalpine species is very rare also in Fennoscandia.

scandia (Erlandsson 1955, Rassi & Väisänen 1987). It is known to parasitize on *Megachile nigriventris*, a big leafcutting bee that occurs in the Ridö archipelago. *C. lanceolata* is considered to be on the edge of extinction in Germany, where it is only known from Bavaria (Blab et al. 1984), and it is possible that it should be given a similar status in Sweden. The single female collected in the area (18-24.VI.89., Solbacken) was caught in a Malaise trap near some dry barkless sun-exposed oak logs.

Concluding remarks

When compared to other areas, even entire provinces or countries, the Ridö archipelago contains an impressive number of wood- and stem-nesting aculeate species. Even so, it is evident that there are still species in the area that remain to be found. For example, three sphecids wasps species, *Spilomena beata*, *Lestica clypeata* and *Rhopalum nigritum*, and two megachilid bees, *Anthidium manicatum* and *Megachile lapponica*, were found in the Ridö archipelago or at Solbacken for the first time in 1990, i.e. during the 9th year of the survey. Indeed, of the 222 aculeate species recorded in the Ridö archipelago and at Solbacken so far, 66 have been found only as single specimens. Moreover, although all biotopes at Solbacken occur in the Ridö archipelago, extensive collecting activity at Solbacken has resulted in 72 species hitherto not recorded from the archipelago. Thus, there is every reason to expect further interesting records from the Ridö archipelago, provided that this elsewhere increasingly rare mixture of biotopes will continue to exist within the archipelago also in the future.

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Sammanfattning

Gaddstekelfaunan i Ridöarkipelagens naturreservat (SÖ och VS) samt Solbacken, ett angränsande strandområde i VS, har inventerats under 1982–1990. Sammanlagt har 222 arter insamlats, vilket utgör 45 % av den svenska faunan av de studerade gaddstekelfamiljerna. Den vedlevande gaddstekelfaunan visade sig vara extremt rik, sannolikt oöverträffad i Nordeuropa. Bl a påträffades 57 arter vedlevande rovsteklar (Sphecidae), vilket är samma antal som har påträffats i Danmark, och mer än vad som är känt från t ex Skåne, Öland eller Gotland. Av vedlevande buksamlarbin (Megachilidae) påträffades 26 arter, vilket utgör 81 % av den svenska faunan. Mångfalden av vedlevande gaddsteklar torde hänga samman med den rika förekomsten av murken ved i kombination med en rik flora gynnad av bl a kreatursbete. Ett flertal av arterna är troligen bundna till ädellövskogen, vilken delvis är urskogsartad. Några arter verkar vara mer eller mindre knutna till vasstak på gamla lador. Av de påträffade gaddstekelarterna förekommer 35 på en eller flera europeiska hotlistor.